species of this fungi." One figure shows "the zones of annual growth, termed the medullary rays." Again, we have an account of the "*Bryozoa Bowerbankia*;" with abstracts from Quekett's *Historical Catalogue*. Also a host of misspelt words; and these not occurring accidentally, but frequently repeated: thus, *Astatia, Plurosigma, Volvox globata, Saccina ventriculi*, &c. The author has also an insuperable difficulty in the distinction of the singular from the plural. Thus, we have "*Torulæ diabetica*;" "the *Entozoa folliculorum* is," &c.; "*Vibrio spirilla* or *trembling animalculæ* appear," &c. The words *animalculæ* and *spiculæ* are constantly used. The author's knowledge of chemistry is also extremely small, for we are told that the "invaluable agent, *Formic acid* or *Chloroform*, was first discovered in, and produced from, the *Formic ant*;" and that the "contents of the cells of the yeast-plant resemble fat or oil, a protenic substance."

In short, the work is evidently written by one who has amused himself with the examination of mounted microscopic objects, but who can lay no claims to the character of a man of science, and who is very ill-calculated to write a popular work. The book is just that which we should have expected from one of those uneducated men, highly useful in their way, who obtain their livelihood by preparing and mounting microscopic objects; but it is a discreditable production from the pen of a member of the learned profession to which the author belongs. The part of the publishers has been well performed, and many of the woodcuts are very beautifully executed.

PROCEEDINGS OF LEARNED SOCIETIES.

ROYAL SOCIETY.

April 6, 1854.—Thomas Graham, Esq., V.P., in the Chair.

"On a peculiar Arrangement of the Sanguiferous System in *Terebratula* and certain other Brachiopoda." By W. B. Carpenter, M.D., F.R.S.

In a memoir "On the Minute Structure of Shell," read before the Royal Society January 17, 1843, (and subsequently embodied in a "Report" on the same subject, prepared at the request of the British Association for the Advancement of Science, and published in its Transactions for 1844,) I first announced the fact, that the 'punctations' which had been previously noticed on the exterior of many Brachiopodous shells, both recent and fossil, are really the orifices of *tubular perforations*, which pass directly through each valve, from one of its surfaces to the other (fig. 1).

Having subsequently obtained specimens of *Terebratulæ* in which the soft parts of the animals had been preserved, in connection with their shells, I ascertained that these passages are occupied in the living state by membranous cæca, *closed externally*, but opening on the *internal* surface of the shell, and filled with minute cells of a brownish hue. Recollecting that Professor Owen, in his account of dissections of some species of *Terebratula* and *Orbicula* (Transactions of the Zoological Society, vol. i.), had spoken of an unusual adhesion of the mantle to the shell in these Bivalves, it occurred to me that this adhesion might be due to a continuity between the mantle and these cæcal tubuli; and I carefully sought for evidence of such a structure. In this, however, I was entirely unsuccessful; for the mantle, when stripped from the shell, presented no appearance whatever of having transmitted any such prolongations into its substance; on the contrary, it was evidently continued over the mouths of the cæca with which it was in apposition; and I frequently found its external surface (*that* in contact with the shell) covered *in patches* with cells exactly resembling in size and aspect those contained within the cæca. I was equally unsuccessful in the attempt to trace any other connection between these cæca and the soft parts of the animal; so that, although their importance in its œconomy scarcely admitted of doubt, the nature of their function remained entirely unknown. The idea that they had any connection with the formation of the *shell* itself, seemed to be completely negatived by the fact, that in a large proportion of the group of BRACHIOPODA, no such perforations exist; notwithstanding that their shells, in every other feature of minute structure, are exactly accordant with that of *Terebratula*.—The foregoing results were communicated to the British Scientific Association in 1847, and were embodied in the Second Part of my "Report" published in its Transactions for that year.

The physiological importance of the characters of 'perforation' or 'non-perforation' has become continually more obvious, as the principles on which the subdivision of the group of Brachiopoda should be founded, have been gradually settled by those who have concerned themselves with its systematic arrangement; and in particular, the *universal presence* of the perforations in the shells of the family *Terebratulidæ*, contrasted with their equally universal absence in those of the family *Rhynchonellidæ*, unequivocally marked its relation to the general conformation of the *animals* of these subdivisions.

Having been requested by Mr. Davidson to undertake a more detailed investigation than I had yet made, into the minute structure of the shells of Brachiopoda, for the sake of throwing still further light upon the classification of the group, I applied myself afresh to the solution of the problem, and believing that I have succeeded in ascertaining the import of this curious feature in the organization of Terebratula and its allies, I beg to offer an account of my results to the Royal Society.

The membrane which is commonly spoken of as 'the mantle,' and which may be stripped from the shell by the use of sufficient force to overcome its adhesions, must, I maintain, be considered as really its *inner layer* only; for I find that an outer layer exists, so intimately incorporated with the shell as not to be separable from it without the removal of its calcareous component by maceration in dilute acid. When thus detached, this outer layer is found to be continuous with the membrane lining the perforations in the shell (fig. 1 *b*); so that their tubular cæca are, in fact, prolongations of the *real* external surface of the mantle. The adhesion of the *inner* to the *outer*

Fig. 1.

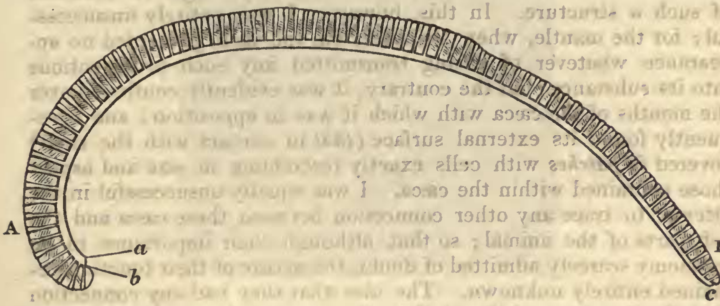
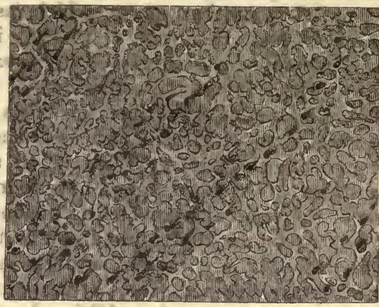


Diagram of the intra-palleal sinus-system of *Terebratula*, with its cæcal prolongations into the shell;—A, B, section of valve; *a*, inner layer of mantle, *b*, outer layer in contact with the shell, and giving off cæca; *c*, continuity of the two at margin of valve.

layer (which Professor Owen, not being aware of the existence of an outer layer, interpreted as an adhesion of the *mantle* to the *shell*) does not extend to the whole of the contiguous surfaces, but is limited to certain bands or spots,—the two layers of membrane, in the intervals between these, being separated by a set of irregular spaces, freely communicating with one another, and with the cavities of the cæca, so as to form a rude network. This arrangement is peculiarly well marked in *Terebratula caput-serpentis*, as shown in the figure (fig. 2); and to those who are familiar with the condition of the circulating apparatus in the inferior Mollusca, it is scarcely possible not to recognize in it a 'sinus-system,' corresponding to that which is formed in the Tunicata by the partial adhesion of the second and third tunics to each other.

Considered under this point of view, the cæcal structure (as was first suggested to me by my friend Mr. T. H. Huxley) bears a close resemblance to the vascular prolongations, which, in many Ascidians, pass from the sinus-system into the substance of the 'test;' the chief difference lying in this,—that whilst each of the vascular prolongations into the 'test' of the Ascidians contains both an *afferent* and an *efferent* canal,—no such distinction ordinarily manifests itself in these prolongations of the intra-palleal sinus-system of *Terebratula*, although I have met with indications of it in *Crania*. Their cæcal character, however, is by no means opposed to the views I am now giving of their physiological nature; for it has been shown by M. de Quatrefages, that the prolongations of the 'general cavity of the body,' which pass into the branchiæ and other appendages of Annelida, transmitting to them its nutritive fluid for aëration, are always cæcal, notwithstanding that they are sometimes distributed as minutely as blood-vessels*.

Fig. 2.



Sinus-system of *Terebratula caput-serpentis* (as shown by the grinding away of the shell, without detaching the mantle), being a network of canals formed by the adhesion of the two layers of the mantle at certain spots, leaving passages around them.

On this interpretation, the cells which are found within the cæca, and in the spaces between the contiguous surfaces of the two layers of the mantle, are to be regarded as *blood-corpuscles*, and they correspond in size and appearance (so far as can be determined by specimens preserved in spirits) with the blood-corpuscles of Ascidian and Lamellibranchiate Mollusks.

The sinus-system from which this collection of cæca proceeds, appears to be altogether distinct from the vascular apparatus of the (so-called) 'mantle,' (that is, according to my interpretation, *of the inner layer* of the mantle) which has been described by Professor Owen; but it probably communicates with the 'common sinus' at the back part of the visceral chamber, which is stated by Professor Owen to receive the blood, not only from the palleal sinuses of the dorsal and ventral valves, but also from "other sinuses that there fill, line, and seem to form, the visceral or peritoneal cavity†."

It cannot be deemed improbable, then, that the apparatus in question is *branchial* in its nature; and that it is designed to provide for certain tribes a more special means of aërating the blood, than is afforded by that distribution of blood to the general surface of the mantle, which is common to the entire group. This view of its respiratory office is confirmed by an observation communicated to me by Professor Quekett; viz. that the discoidal opercula which cover the external orifices of the cæca, and which, though adherent to the periostracum, are not structurally continuous with it, present appearances in young shells, which seem indicative of the existence of

* Ann. des Sci. Nat., 3e sér., Zool., tom. xviii. p. 307.

† See Mr. Davidson's Monograph on the "British Fossil Brachiopoda," published by the Palæontographical Society, vol. i. p. 15.

a fringe of cilia round each, designed to produce currents of water over the extremities of the cæca.

The resemblance which these cæcal prolongations of the sinus-system into the shell of the *Terebratula* bear to the vascular prolongations of the sinus-system into the test of certain *Ascidians*, is not without its parallel in another group, which (as pointed out by Mr. Hancock, Ann. of Nat. Hist. vol. v. p. 198) is intimately related to that of Brachiopoda,—namely, the *Bryozoa*. The stony walls of the 'cells' which invest the soft bodies of many species of *Eschara*, *Lepralia*, &c., are marked, like the shells of Terebratulæ, with punctations, which are really the orifices of short passages extending into them from their internal cavity, as sections of these structures demonstrate. These passages I have found to be occupied by prolongations of the visceral sac, which is the only representative of a circulating system among these animals; and they thus convey the nutrient fluid which this contains, into the substance of the framework formed by the calcified tunics of these animals.

I need not here enlarge upon the additional value which these structural and physiological considerations afford, to the character of "perforation" or "non-perforation" in the shells of Brachiopoda. The importance of this character in systematic arrangement will plainly appear, I think, from the details which I have published in the Introduction to Mr. Davidson's Monograph already referred to.

March 30, 1854.—Thomas Bell, Esq., V.P., in the Chair.

"On the Structure and Affinities of *Trigonocarpon* (a fossil fruit of the Coal-measures)." By Joseph D. Hooker, M.D., F.R.S.

Having been for some time engaged in examining the structure and affinities of some fossil fruits of the coal formation, included under the name *Trigonocarpon*, and the progress which I am enabled to make being extremely slow (owing to the difficulty of procuring good specimens), I am induced to lay before the Royal Society such results as I have arrived at, for publication in their Proceedings (if thought worthy of that honour). The details and illustrations of the subject will, when complete, be offered to the Geological Society of London.

My attention has for many years been directed to the genus *Trigonocarpon*; as, from the period of my earliest acquaintance with the flora of the carboniferous epoch, I have felt assured, that botanically, this was the most interesting and important fossil which it contained in any great abundance, and that until the affinities of this were determined, the real nature of the flora in question could never be regarded as even approximately ascertained.

In the first place, *Trigonocarpon* is so abundant throughout the coal-measures, that in certain localities some species may be procured by the bushel; nor is there any part of the formation in which they do not occur, except the underclays and limestone. The sandstone, ironstones, shales, and coal itself, all contain them.

Secondly. The symmetry in form and size which many of them display, the regularity of the sculpturing on their surfaces, and various other points, suggested their belonging to a class of highly organized vegetables.

Thirdly. The fact of our being wholly unacquainted with the organs of fructification belonging to the exogenous vegetation, which also abounds in the coal formation, coupled with the assumed highly organized nature of *Trigonocarpon*, favoured the assumption that these might throw light upon one another, and seemed to afford a legitimate basis upon which to proceed, should I ever procure specimens of *Trigonocarpon* displaying structure, which I had long hoped to do.

It is, however, only since my return from India that I have been so fortunate as to obtain good specimens, and for these I am indebted to my friend Mr. Binney of Manchester, who has himself thrown much light upon the vegetation of the coal epoch, and whose exertions indeed have alone enabled me to prosecute the subject; since he has not only placed his whole collection of Trigonocarpons at my disposal, but has shared with me the trouble and expense of their preparation for study. All the specimens were found imbedded in a very tough and hard black-band or clay ironstone, full of fragments of vegetable matter, and which appears originally to have been a fine tenacious clay.

The individual Trigonocarpons are exposed by breaking this rock, and are invariably so intimately adherent to the matrix as to be fractured with it. A great many of these lumps of ironstone, containing partially exposed Trigonocarpons, have been sliced by a lapidary in the usual manner, and excessively thin sections taken on slips of glass. The sections were made necessarily very much at random, but as nearly as possible parallel, or at right angles to the long diameter of the fruit. Five of the specimens thus operated upon have proved instructive, presenting the same appearances, and all being intelligible, and referable to one highly developed type of plants. As, however, the term 'highly developed' may appear ambiguous, especially with reference to a higher or lower degree in the scale of vegetable life, I may mention that by this term I mean to imply that there are in the fruit of *Trigonocarpon* extensive modifications of elementary organs, for the purpose of their adaptation to special functions, and that these modifications are as great, and the adaptation as special, as any to be found amongst analogous fruits in the existing vegetable world.

Thus, I find that the integuments of the fruit of *Trigonocarpon* are each of them a special highly organized structure; they are modifications of the several coats of one ovule, and indeed of the same number of integuments as now prevail in the ovules of living plants.

The number, structure and superposition of these, are strongly indicative of the Trigonocarpons having belonged to that large section of existing coniferous plants, which bear fleshy, solitary fruits, and not cones; and they so strongly resemble the various parts of the fruit of the Chinese genus *Salisburia*, that, in the present state of our knowledge, it appears legitimate to assume their relationship to it.

In all the five specimens alluded to, there are more or less perfect evidences of four distinct integuments, and of a large cavity, which is in all filled with carbonate of lime and magnesia; these minerals, I presume, having replaced the albumen and embryo of the seed.

The general form of the perfect fruit is an elongated ovoid (rather larger than a hazel nut), of which the broader or lower end presents the point of attachment, while the upper or smaller end is produced into a straight, conical, truncated rostrum or beak, which is perforated by a straight longitudinal canal. The exterior integument is very thick and cellular, and was no doubt once fleshy; it alone is produced beyond the seed and forms the beak; its apex I assume to have been that of the primine of the ovule, and its cavity the exostome. The second coat appears to have been much thinner, but hard and woody or bony; it is impervious at the apex; is also ovoid, and sessile by its broad base within the outer integument, with which it is perhaps adherent everywhere except at the apex. This is marked by three angles or ridges, and being that alone which (owing to its hard nature) commonly remains in the fossil state, has suggested the name of *Trigonocarpon*. Within this are the third and fourth coats, both of which are very delicate membranes; one appears to have been in close apposition with the inner wall of the second integument, and the other to have surrounded the albumen. These are now separated both from one another, and from the inner wall of the cavity, by the shrinking of the contents of the latter, and the subsequent infiltration of water charged with mineral matter. I may remark, however, that these two membranes may be due to the separation of one into two plates, in which case the original one was formed of several layers of cells. Hitherto I have not been able to trace any organized structure within the cavity of the fruit, and its real nature therefore remains doubtful. It is only from the strong resemblance, in structure, appearance and superposition, which these integuments present to those of Taxoid Coniferæ, that I assume their probable relationship. *Salisburia*, especially, has the same ovoid fruit, sessile by its broader end, and its outer coat is perfectly analogous, being thick, fleshy, and perforated at its apex by a longitudinal canal (the exostome of the ovule); within this is a perfectly similar, woody, two- or three-angled, impervious integument, forming the nut. This again is lined with one very delicate membrane, and contains a mass of albumen covered with a second similar membrane. A marked analogy is presented to the European botanist by the fruit of the Yew, which has the same integuments though somewhat modified; the outer, fleshy coat in the Yew is however a cup-shaped receptacle, and not drawn up over the nut so as to leave only a small canal at the top, as in *Salisburia* and *Trigonocarpon*. The nut also does not adhere to the fleshy cup except below its middle. The internal structure is the same in all three.

Such are the main facts which I have been able satisfactorily to establish. There are many others yet to be worked out, especially those connected with the individual tissues of which those bodies are composed; and it is particularly to be borne in mind that the discovery of some structure indicative of albumen or embryo, is absolutely essential to the complete establishment of the affinity I have suggested.

It must not be overlooked, that the characters through which I have attempted to establish an affinity between *Trigonocarpon* and Coniferæ are equally common to the fruits of Cycadeæ; and in connexion with this subject I may remark, that M. Brongniart* has referred the genus *Noggerathia*, which is also found in the coal-measures, to that natural order, together with some associated organs which are probably Trigonocarpons in a mutilated state. The leaves of *Noggerathia* are, however, alone known, and Dr. Lindley, when figuring those of one species (Lindley and Hutton, Fossil Flora, 28, 29), pointed out their great resemblance to those of *Salisburia*, thus affording collateral evidence of the view I have been led to adopt from an examination of the fruit alone.

May 11, 1854.—The Earl of Rosse, President, in the Chair.

"On the relation of the Angular Aperture of the Object-Glasses of Compound Microscopes to their penetrating power and to Oblique Light." By J. W. Griffith, M.D., F.L.S.

The explanation given by Dr. Goring and others of the advantage of increased angular aperture in microscopic objective-glasses appears to the author to be correct, as applied to the case of opake objects, and accordingly his remarks in the present communication have reference to transparent objects only.

It is known that delicate markings on a transparent object, such as the valve of a *Gyrosigma*, may be rendered more distinctly visible by using an object-glass of large aperture, by bringing the mirror to one side, and by placing a central stop in the object-glass or the condenser or in both; the increased distinctness produced in these several ways being due to the illumination of the object by oblique light. Experiment also shows that the degree of obliquity of the light requisite varies with the delicacy or fineness of the markings, being greater as these are more delicate; so that the finest markings require the most oblique light which can possibly be obtained to render them evident, and the angular aperture of the object-glass must necessarily be proportionately large, otherwise none of these oblique rays could enter it.

If the parts of an object which refract the light are large in proportion to the power of the object-glass and of irregular form, they will refract a certain number of rays, so that these cannot enter the object-glass; hence certain parts will become dark, and will map out, as it were, in the image formed of the object, the structural peculiarities of the same. But if the parts are minute, of a curved form and approximatively symmetrical, they will act upon the light transmitted through them in the manner of lenses, and their luminous or dark appearance will vary according to the relation of the foci of these to that of the object-glass. Thus the parts of an object may appear

* Annales des Sciences Naturelles, 2nd Series, vol. v. p. 52.

dark and defined, from the refraction of the light out of the field of the microscope; also, from the concentration or dispersion of portions of the light by these parts, all the rays being admitted by the object-glass, or entering the field.

Another condition affecting distinctness consists in the relation which the luminousness or darkness of an object bears to that of the field or back ground upon which it is apparently situated.

The refraction of the light out of the field of the microscope or beyond the angle of aperture of the object-glass is the ordinary cause of the outlines of objects becoming visible; and in these cases, an increase of the angular aperture of the object-glass will impair their distinctness, because it will allow of the admission of those rays which would otherwise have been refracted from the field, and the margins will become more luminous and less contrasted with the luminous field.

The cause of the distinctness of an object by refraction when all or nearly all the rays enter the field of the microscope, may be investigated in a drop of oil immersed in water, or in a drop of milk, as illuminated by light reflected from an ordinary mirror. The refractive power of the globules is so great and their form such, that each acts as a minute spherical lens; and the parts within the margin will appear light or dark according to the relation of the focus of the little lens to that of the object-glass. Under an object-glass of small aperture and moderate power the outline will appear black, because the marginal rays do not enter the object-glass. If the object-glass be of sufficient aperture to admit these marginal rays, the black margin will disappear, and the little lens will only be distinguishable by the above focal relation. Its appearance under oblique light (thrown from all sides, as when the condenser and a central stop are used) will vary; but taking the case of extreme obliquity of the rays, the lens will only be visible by a luminous margin from reflexion, giving it a very beautiful annular appearance. Hence it is more distinct by direct, or slightly oblique, than by very oblique light.

But in certain objects, the irregularities of structure are of such extreme minuteness, or the difference of the refractive power of the various portions of the structure is so slight, that the course of the rays is but little altered by refraction on passing through them, and, under ordinary illumination, all the rays will enter the object-glass; neither are the rays accumulated into little cones or parcels, of sufficient intensity to map out the little light or dark spots in the field of the microscope, according to the relation of their foci with that of the object-glass.

Let us take the instance of an object with minute depressions on the surface, as the valve of a *Gyrosigma*. These are so minute, that when the light reflected from the ordinary mirror is used, the rays passing through the depressed and the undepressed portions, are not sufficiently refracted to cause either set to be excluded from the object-glass, consequently both sets will enter it. The slightly oblique and converging rays passing through a portion of the valve become separated into two sets, one passing through the thinner depressed portions, the other through the thicker and undepressed portions: still both sets enter the object-glass. But on transmitting oblique light through the object, one set of the rays will be refracted so as not to enter the object-glass, whilst the other set will gain admission; thus the two parts, which have differently refracted the rays, will become distinct. If the markings were more delicate, or if the difference between the refractive power of the two portions of the valve were less, both sets would enter the object-glass. But on rendering the light still more oblique, one set would be again excluded by being refracted out of the field. Hence it is evident why the angular aperture of the object-glass must be larger as the markings are finer, or the difference between the refractive power of the two portions of tissue is less; because the obliquity of the light requisite will be very great to cause the exclusion of one set of the rays, and the other set will be too oblique to enter the object-glass unless it be of correspondingly large aperture. This is the explanation of the advantage of oblique light. It has no peculiar power of rendering objects distinct, as has sometimes been believed, and the following experiment, supposed to show such peculiar power, is really to be explained on different grounds. A piece of net, or some similar texture, is placed behind a hole made in a window-shutter, and when thus viewed, the fibres are not well seen; but when the texture is moved on one side, they become very distinctly visible, and this has been erroneously attributed to the illumination by oblique light; whereas the increased distinctness in the lateral position is owing principally to the circumstance that the object is then viewed on a dark instead of a white ground as in the first instance; although it is also true that in this position the oblique rays, being reflected in large numbers from the fibres into the eye, contribute to the distinct vision of the object when viewed as it then is upon a dark ground.

The most difficult point has been to explain, how an object-glass of large angular aperture will render markings evident, which were not visible under an object-glass of smaller aperture; because it would naturally be imagined that the larger aperture would admit both sets of rays, one of which was excluded by the object-glass of smaller aperture. The difficulty vanishes when it is recollected that the additional rays admitted by the object-glass of larger aperture are more oblique; hence one set of these rays will be refracted from the field of the microscope, whilst the other set will enter the object-glass and will illuminate the more highly refractive parts of the object; thus the two kinds of differently refractive structure become distinctly separated, one appearing dark, the other luminous; in fact, by means of the additional rays admitted by the larger aperture we illuminate more highly one part of the object whilst the illumination of the other is not increased. In short, the object is illuminated, first, by rays corresponding to those admitted by an object-glass of small aperture; and, secondly, by the additional rays admitted by the object-glass of larger aperture. The first set not being sufficiently oblique, no part of them is refracted beyond the angular aperture of the object-glass; the second, being more oblique, are refracted out of the field by certain parts of the object and not by others, and thus contribute to render its different parts distinguishable by contrast of darkness and illumination. The first set of rays, by illuminating all parts of the object, tend to diminish this contrast, and consequently do not add to but impair the discriminative power of the object-glass for the fine markings of transparent objects, and accordingly these are rendered more distinctly visible by intercepting the less oblique rays by means of a central stop.

It has been here assumed that the oblique light requisite for the display of the markings upon objects is separated into two sets of rays by refraction; but the author observes that it might be questioned whether they are not separated by reflexion. There can be no doubt that the latter is not generally the case; perhaps the most important reason which may be assigned for this is, the considerable comparative breadth of the luminous portions of the valve of the *Gyrosigma* for instance. On transmitting unilateral light obliquely through the valve of an *Isthmia*, in which the depressions are so large, in such manner that part of it is reflected by portions of them, it is easily seen how small the amount of reflected light is; and this because the surface of the depressions is curved, and thus the portions inclined at the requisite angle for reflexion are also very small. As the amount of light reflected is so small in this case, it would be inappreciable in that of the *Gyrosigma*, in which the depressions are so exceedingly minute. In fact, attention to this point affords a ready means of distinguishing whether an object is illuminated by reflexion or refraction.

The author next considers the relation of the *penetrating* power of an object-glass to its *defining* power. Penetrating power depends upon angular aperture, and consequently on oblique light. The question whether there be any essential difference between penetrating and defining power is best answered by experiment. If we take a fragment of the valve of an *Isthmia* and examine it under a high power of small aperture, all the parts are very distinctly seen by the ordinary light of the mirror; and the various depths of shadow of the different parts of the depressions and the undepressed portions render these also clearly distinguishable; and when an object-glass of very large aperture is used, the distinctness is rather impaired than improved. But if we examine a fragment of the valve of a *Gyrosigma*, and this requires an object-glass of large aperture to render the markings visible, no distinction of the various parts of the depressions and the undepressed portions is visible; all we see is, that the depressions as a whole are dark and the undepressed portions are luminous. Hence the *Isthmia* requires defining power, whilst the *Gyrosigma* requires penetrating power or large angle of aperture to exhibit the markings; yet the structures differ only in size. And there can be no doubt that if we could examine the valve of the *Gyrosigma* under a power as high relatively to the size of the depressions, as that under which we can examine the *Isthmia*, the same relations being preserved between the angle of aperture of the object-glass and the angular inclination of the refracted rays, the various parts of the depressed and undepressed portions would be equally recognizable in both cases.

This is also true of fine lines scratched or etched on glass; for although the coarser lines upon glass micrometers are well seen with an object-glass of small aperture with good defining power and direct light, yet the finest lines upon Nobert's test-slide require penetrating power in the object-glass, and oblique light. Large angular aperture or *penetrating* power is but a very imperfect substitute for *defining* power—an important point which the author believes has not hitherto been noticed, and to which he would invite the earnest attention of object-glass makers.

The author concludes by observing that his remarks have been principally confined to one class of objects requiring penetrating power, viz. the valves of the Diatomaceæ. This has been done advisedly, because the scales of insects, which may be regarded as forming the type of the other class, involve considerations of a mixed kind, which would have tended to confuse the subject. The longitudinal ridges upon the scales of insects, in their relation to penetration, may be viewed as representing the undepressed portions of the valves of the Diatomaceæ; and the same explanation will apply to the visibility of both under various conditions. The transverse lines seen upon the scales are not indications of true structure; but their origin, as also that of the lines seen upon the valves of the Diatomaceæ, from circular or angular depressions, does not come within the conditions involved in the principle which it has been the object here to elucidate. It will suffice to say that the true structures producing the appearance of transverse markings upon the scales of insects are best resolved by small angular aperture and good definition.

It has been assumed also, that the markings upon the valves of the Diatomaceæ arise from depressions. This can be proved to be the case in the larger ones (*Isthmia*, &c.); and there is sufficient evidence to render it at least highly probable in the remainder. But this is an unessential point as regards the principle, and therefore it has not been dwelt upon.

ZOOLOGICAL SOCIETY.

February 10, 1852.—W. Yarrell, Esq., in the Chair.

Monograph of the Family Branchipodidæ, a family of Crustaceans belonging to the Division Entomostraca, with a description of a new genus and species of the family, and two new species belonging to the family Limnadiadæ. By W. Baird, M.D., F.L.S. &c.

Next to the *Apodidæ*, the largest species of *Entomostraca* belong to the family *Branchipodidæ*. This family contains perhaps the most